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KARPINSKY'S GENUS HELICOPRION.

A REVIEW.

C. R. EASTMAN.

IT is a significant and decidedly unwelcome truth that not one in one hundred essays on paleontological subjects receives anything like the elaborate care and finish which Dr. Karpinsky,[1] the Director of the Imperial Russian Geological Survey, has bestowed upon the remarkable ichthyodorulites which he describes under the name of "Helicoprion." Within the compass of 110 pages, enriched by seventy-two text-figures and four quarto plates, the subject is treated from all possible standpoints — historical, geological, chemical, histological, and biological. The result is a very gratifying addition to the knowledge of Palæozoic fishes.

Helicoprion is a fitting title for the peculiar "spiral saws," coiled in three and a half whorls and armed with upwards of 150 sharp teeth, which have recently been discovered in the Permo-Carboniferous (Artinsk Series) of the government of Perm. Although ammonitic in outward appearance, inspection shows these bodies to be of elasmobranch nature, the nearest allied structures being found amongst the Edestidæ. A complete summary of the literature of Edestidæ is given in the first twenty pages, with text-figures of all the more important species that have been described. Next follows a discussion of the stratigraphic position of the Russian specimens, and finally a minute account of their form, structure, and general nature. At the end the results of the investigation are tabulated under sixteen different headings, and a restoration is attempted showing the imaginary position occupied by the spiral during life of the creature. Few will be prepared to admit, however, that this highly fanciful sketch can be taken seriously, and, therefore, the least said about it the better.

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[1] Karpinsky, A. Ueber die Reste von Edestiden und die neue Gattung Helicoprion, *Verh. k. russ. min. Ges. St. Petersburg*, Ser. 2, Bd. xxvi, No. 2, 1899.

Of the two leading theories as to the position in the body of Edestus "spines," the first ascribes them to the jaws of a shark or skate, and the other to the median line of the back, some distance in advance of the dorsal fin or in a cephalic position. Dr. Bashford Dean[1] confidently asserts that the evidence of *Edestus lecontei* leaves no room to doubt that "the spine had its origin as a metameral structure whose basal portion lay within the integument, and traversed longitudinally a number (seven at least) of body segments." This supposed metameral origin of Edestus is still more strongly insisted on by the same author in his *Fishes, Living and Fossil* (pp. 28–30). On the other hand, those who deny that these structures are dermal defenses and regard them as part of the dentition are impressed by the close similarity in form and structure of the enameled denticles as compared with ordinary sharks' teeth, especially those of Carcharodon and certain Palæozoic genera. As it is difficult to conceive of such unwieldy, bilaterally symmetrical bodies being located within the mouth cavity, they have been compared by the elder Agassiz with the rostrum of swordfishes, and by Miss Hitchcock with the symphysial dentition of Onychodus. Dr. Karpinsky's conclusion that the spiral was external and attached to the upper jaw in the manner shown is based on the following considerations: (1) Helicoprion belongs undoubtedly to an elasmobranch; (2) the bases of all the segments ("teeth") of the spiral were imbedded in the soft parts of the fish; (3) the spiral must have been situated in the median vertical plane of the fish; (4) the whole of the spiral, except the large end, must have been exposed; and (5) the large size of the spiral (26 cm. in diameter) renders it highly improbable that it could have been contained within the mouth cavity.

Dr. A. S. Woodward,[2] in a review of Karpinsky's memoir, likewise admits that "the conception of a gigantic shark armed in both jaws with several series (whorls) of teeth, like those

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[1] *Trans. New York Acad. Sci.*, vol. xv (1897), p. 68.

[2] *Geol. Mag.*, vol. vii (1900), p. 36.

now described under the name of Helicoprion, is, indeed, sufficiently startling." Nevertheless this distinguished expert brings forward considerable evidence in favor of the view that Edestus and Helicoprion should be looked upon as Palæozoic sharks "with sharp, piercing teeth, which were never shed, but became fused into whorls as the animal grew." The question, then, as to whether these objects are segmented spines or teeth would seem to remain as puzzling as ever, in spite of the abundance of new light thrown on their structure by Karpinsky's studies. Analogy alone is insufficient to settle the problem; we must have the positive evidence that only fresh material can supply. Should several whorls, or "spines," be discovered in natural association, that is, belonging to one individual, it would be a fatal argument against their being dermal defenses, and we should have to look upon them as actual, veritable teeth, as suspected by Woodward.

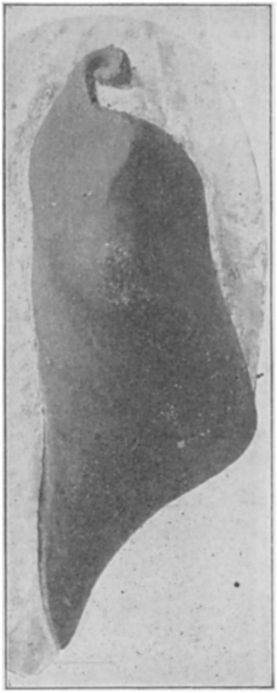

Fig. 1.— *Sandalodus larvissimus.* N and W. Keokuk limestone, Keokuk, Iowa. Posterior dental plate of left mandibular ramus. × ⅔.

As far as analogy goes, however, no one can deny that there are a number of points in common between the segments of Helicoprion and various forms of cochliodont and petalodont dentition, where the earlier formed teeth are permanently retained, and there are all degrees of fusion and coiling. Karpinsky himself calls attention to certain points of similarity in the structure of Janassa, Glossodus, and Helodus, and since his memoir appeared an important paper on the dentition of the first-named genus has been published by Jaekel,[1] which calls to mind more forcibly than ever the resemblance to a portion of the whorls of Helicoprion. As for *Helodus coxanus*, cited by the Russian director, it may be remarked that, after a study of the type specimen (now in the keeping of the U. S. National Museum) in connection with a large series of dental plates of *Cochliodus latus* from the same horizon, the reviewer is satisfied that they were associated in one and the same mouth. *H. coxanus* is, accordingly, but another name for one of the several arched series of knob-like teeth situated in advance of the large pair of dental plates in the upper and lower jaws of *Cochliodus latus*.

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[1] Jaekel, O. Ueber die Organisation der Petalodonten, *Zeitschr. d. d. geol. Ges.*, Bd. li (1899), pp. 258–298. *Cf.* Text-fig. 1, p. 265.

A very curious case of coiling among cochliodonts which has not been previously reported occurs in *Sandalodus lævissimus*, which accompanies *Cochliodus latus* in the Keokuk limestone of Iowa and Illinois. The initial portion of the large posterior dental plate is wound upon itself one and a half times before expanding into the functional grinding surface characterizing the adult, and in *Deltodus undulatus* from the Burlington limestone a like condition obtains on a somewhat smaller scale. These instances deserve notice, when we consider the variety of evidence it is necessary to take into account before passing judgment on the extremely problematical nature of the Edestidæ. In Fig. 1 is shown one of the most perfect examples of Sandalodus ever discovered, and its bearing on the present subject will be evident from inspection.